NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)

OPERATIONAL ALGORITHM DESCRIPTION DOCUMENT FOR VIIRS SEA ICE AGE EDR SOFTWARE (D39593 Rev A)

CDRL No. A032

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Revision/Change Record

Document Number **D39593**

Revision	Document Date	Revision/Change Description	Pages Affected
---	5-6-05	Initial PCIM Release – Reference ECR A049.	All
A1	6-5-06	11Oct05 – Inserted the NP-EMD.2005.510.0115 Tech Memo changes plus reflects Raytheon-Omaha's edits for Science To Operational Code Conversion (i.e., added Raytheon coversheet, Raytheon title signature page, etc.) 03Apr06 – Removed Ice Quality and Ice Concentration information, updated coversheet copyright year, corrected info on TBD/TBR page, removed Figures 1, 2, 3, updated Table of Contents, updated List of Figures, updated List of Tables. 05Apr06 – Added information from 23Mar06 I-P-O CUTPR code comments into Section 2.3 (Detailed Algorithm Description) and corrected info on TBD/TBR page. 06Apr06 – Per precedence to separate out all three Ice Characterization executables into individual OADs, updated the document number (i.e., D39593-IDP-003) in upper right header. Ice Quality OAD (i.e., D39593-IDP-001) and Ice Concentration (i.e., D39593-IDP-002). Updated coversheet title to All Capital letters and spelled out "EDR" acronym. Updated TBD/TBR page numbers. Updated Table of Contents to capture insertion of new Sections 2.3.1 through 2.3.14. Made other minor spacing and format edits. 14Apr06 – Removed Table 2's reference to Previous Ice Age Region Mask which was removed from the NP-EMD.2005.510.0115 Tech Memo. Added wsubreg data to Table 3 because it was not added when the NP-EMD.2005.510.0115 Tech Memo was incorporated. 01Jun06 – Updated Table 2's Data Type/Size Column per the NP-EMD.2006.510.0028 Tech Memo. 05 Jun 06 – Final edits.	All
A2	5-16-07	Updated document for TM #: NP-EMD.2005.510.0038. Modified Section 2.2.2, changed HC_ROWS and HC_COLS. Modified Table 9, changed HC_ROWS and HC_COLS, Modified Section 2.2.3.1 added verbiage describing code changes for cross granule processing.	All
A3	6-15-07	Logo, cleanup updates. Delivered to NGST.	All
A4	9-6-07	Updated for the implementation of Tech Memo changes. TM #s: NP-EMD.2006.510.0062, NP-EMD.2006.510.0028, NP-EMD.2006.510.0063, NP-EMD.2006.510.0065, NP-EMD.2006.510.0066, NP-EMD.2006.510.0074, & NP-EMD.2006.510.0083.	All
A5	10-5-07	Updated with correction based on current algorithm processing. Updated with responses to comments from June delivery.	All
A6	10-17-07	Delivered to NGST.	All

Revision/Change Record

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Revision	Document Date	Revision/Change Description	Pages Affected
A7	11-9-07	Added spacecraft position, velocity, and attitude to geolocation output.	All
A8	12-4-07	Updated for the implementation of TM #NP-EMD-2006.510.0095 and comments received from NGST.	All
A9	12-14-07	Delivered to NGST.	All
A10	12-14-07	ECR A-103, EDRPR 1.8 CP 3 updates -Format changes for CDFCB-X compliance- Sea Ice Age Granule-Level Quality Flags table.	All
A11	3-10-08	Implemented TM #NP-EMD-2007.510.0046.	All
A12	10-29-08	Updated Graceful Degradation. Implemented TM #NP-EMD-2008.510.0018. Prepared for TIM/ACCB. Updated for TIM comments.	All
A	12-10-08	Addressed TIM comments. Incorporates ECR A-181. Approved for Public Release per Contracts letter 090618-01.	All

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1.0 INTRODUCTION

1.1 Objective

The purpose of the Operational Algorithm Description (OAD) document is to express, in computer-science terms, the remote sensing algorithms that produce the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) end-user data products. These products are individually known as Raw Data Records (RDRs), Temperature Data Records (TDRs), Sensor Data Records (SDRs) and Environmental Data Records (EDRs). In addition, any Intermediate Products (IPs) produced in the process are also described in the OAD.

The science basis of an algorithm is described in a corresponding Algorithm Theoretical Basis Document (ATBD). The OAD provides a software description of that science as implemented in the operational ground system --- the Data Processing Element (DPE).

The purpose of an OAD is two-fold:

1. Provide initial implementation design guidance to the operational software developer
2. Capture the “as-built” operational implementation of the algorithm reflecting any changes needed to meet operational performance/design requirements

An individual OAD document describes one or more algorithms used in the production of one or more data products. There is a general, but not strict, one-to-one correspondence between OAD and ATBD documents. This particular document describes operational software for the Visible/Infrared Imager/Radiometer Suite (VIIRS) Sea Ice Age Environmental Data Record (EDR).

1.2 Scope

The scope of this document is limited to describing operational algorithm implementation required to create the VIIRS Sea Ice Age EDR software. The theoretical basis for this algorithm is described in Section 3.3 of the VIIRS Sea Ice Characterization ATBD, D41063.

1.3 References

The primary software detailed design documents listed here include science software documents, NPOESS program documents, plus source code and test data references.

1.3.1 Document References

The science and system engineering documents relevant to the algorithms described in this OAD are listed in Table 1.

Table 1. Reference Documents

Document Title	Document Number/Revision	Revision Date
VIIRS Sea Ice Characterization Algorithm Theoretical Basis Document (ATBD)	D41063 Rev. E	14 Apr 2008
NPP EDR Production Report	D37005 Rev. C	16 Mar 2007
CDFCB-X Volume I - Overview	D34862-01 Rev. B	27 Aug 2007
CDFCB-X Volume II – RDR Formats	D34862-02 Rev. B	27 Aug 2007
CDFCB-X Volume III – SDR/TDR Formats	D34862-03 Rev. A	27 Aug 2007
CDFCB-X Volume IV Part 1 – IP/ARP/GEO Formats	D34862-04-01 Rev. A	10 Sep 2007
CDFCB-X Volume IV Part 2 – Atmospheric,	D34862-04-02 Rev. A	10 Sep 2007

Document Title	Document Number/Revision	Revision Date
Clouds, and Imagery EDRs		
CDFCB-X Volume IV Part 3 – Land and Ocean/Water EDRs	D34862-04-03 Rev. A	10 Sep 2007
CDFCB-X Volume IV Part 4 – Earth Radiation Budget EDRs	D34862-04-04 Rev. A	10 Sep 2007
CDFCB-X Volume V - Metadata	D34862-05 Rev. B	27 Aug 2007
CDFCB-X Volume VI – Ancillary Data, Auxiliary Data, Reports, and Messages	D34862-06 Rev. C	10 Sep 2007
CDFCB-X Volume VII – Application Packets	D34862-07 Rev. ---	10 Sep 2007
NPP Mission Data Format Control Book (MDFCB)	GSFC 429-05-02-42 R1	14 Apr 2006
NPP Command and Telemetry (C&T) Handbook	568423 Rev. A	5 Apr 2005
VIIRS Sea Ice Age Unit Level Detailed Design Document	Y3231 Ver. 5 Rev. 5	21 Mar 2005
VIIRS Snow/Ice Module Interface Control Document	Y0011650 Ver. 5 Rev. 5	21 Mar 2005
VIIRS Snow/Ice Module Software Architecture Document	Y2477 Ver. 5 Rev. 6	21 Mar 2005
VIIRS Snow/Ice Module Data Dictionary	Y2482 Ver. 5 Rev. 5	21 Mar 2005
VIIRS Science Algorithms 3.4.5 Delivery to IDPS Package Version Description	D46567 Rev. ---	14 May 2008
Data Processor Inter-subsystem Interface Control Document (DPIS ICD)	D35850 Rev. U.2	27 Aug 2008
EDR Interdependency Report	D36385 Rev. C	7 Nov 2007
D35836_G_NPOESS_Glossary	D35836_G Rev. G	10 Sep 2008
D35838_G_NPOESS_Acronyms	D35838_G Rev. G	10 Sep 2008
Processing SI Common IO Design Document	DD60822-IDP-011 Rev. A	21 June 2007
Operational Algorithm Description Document for VIIRS Sea Ice Quality IP and Surface Temperature IP	D42821 Rev. A6	17 Oct 2007
Operational Algorithm Description Document for VIIRS Sea Ice Concentration IP	D42820 Rev. A5	17 Oct 2007
VIIRS Ice Age LUT Generation document	DAL No. D277c, ITSS Document number ME60822-VIR-022 Rev. ---	2 Dec 2004
NGST/SE technical memo – Cross-granule Processing Memo	NP-EMD.2005.510.0038	7 Mar 2005
NGST/SE technical memo – MS_Engineering_Memo_IceAge_OAD_Update	NP-EMD.2005.510.0115	14 Nov 2005
NGST/SE technical memo – MS_Engineering_Memo_SeaIce_OAD_QualityFlag_Update	NP-EMD.2005.510.0137	14 Nov 2005
NGST/SE technical memo – NPP_VIIRS_IceAge_Ancillary Data EDRIR Compliance	NP-EMD.2006.510.0028 Rev. A	24 Oct 2007
NGST/SE technical memo – NPP_VIIRS_SeaIce_AOT_field_corrections	NP-EMD.2006.510.0047 Rev. A	24 Oct 2007
NGST/SE technical memo – NPP_VIIRS_IceAge_AMI_IP_removal	NP-EMD.2006.510.0062	16 Aug 2006
NGST/SE technical memo – NPP_VIIRS_IceAge_terminator_continuity_fix_Rev A	NP-EMD.2006.510.0063	7 Sep 2006
NGST/SE technical memo –	NP-EMD.2006.510.0065	13 Sep 2006

Document Title	Document Number/Revision	Revision Date
NPP_VIIRS_IceAge_missing_openwater_fill_fix_0065		
NGST/SE technical memo – NPP_VIIRS_IceAge_logical_expression_fixes_066	NP-EMD.2006.510.0066	14 Sep 2006
NGST/SE technical memo – NPP_VIIRS_IceAge_550nmAOT_OAD_update	NP-EMD.2006.510.0074	15 Oct 2006
NGST/SE technical memo – NPP_VIIRS_IceAge_VCM_ThinCirrus_Flag	NP-EMD.2006.510.0083	7 Nov 2006
NGST/SE technical memo – NPP_VIIRS_SeaIce_Night_granule_AOT_RevA	NP-EMD-2006.510.0095 Rev. A	26 Jan 2007
NGST/SE technical memo – NPP_VIIRS_3.4.4_delta_delivery_OAD_update	NP-EMD.2007.510.0046	8 Aug 2007
NGST/SE technical memo – NPP_VIIRS_SeaIce_v3.4.5_delta_delivery_OAD_updates	NP-EMD.2008.510.0018	15 Apr 2008

1.3.2 Source Code References

The science and operational code and associated documentation relevant to the algorithms described in this OAD are listed in Table 2.

Table 2. Source Code References

Reference Title	Reference Tag/Revision	Revision Date
VIIRS Sea Ice Characterization EDR Software Unit Test Document	ISTN_VIIRS_NGST_3.4.5 D41564 Rev. D	8 May 2008
VIIRS Sea Ice Age science-grade software (original reference source)	ISTN_VIIRS_NGST_3.4.5 D46567 Rev. ---	14 May 2008
VIIRS Sea Ice Age Operational Software	B1.5.x.1	24 Oct 2008
NPP_VIIRS_3.4.4_delta_delivery_OAD_update - Tech Memo	NP-EMD.2007.510.0046	08 Aug 2007

2.0 ALGORITHM OVERVIEW

The Sea Ice Age algorithm produces a Sea Ice Age EDR product. The Sea Ice Age EDR is used to report on "Ice free", "New/Young", and "All other ice" classifications at an aggregated cell size of 2x2 VIIRS imagery pixels. Due to the 2x2 imagery pixel aggregation, the Ice Age EDR product size is equal to moderate resolution product size. Therefore, the moderate VIIRS SDR GEO product should be used if geolocation data is needed. The algorithm utilizes Intermediate Product (IP) files produced by other VIIRS algorithms, auxiliary files from the National Center for Environmental Prediction (NCEP) and Lookup Tables (LUT) to produce the output EDRs.

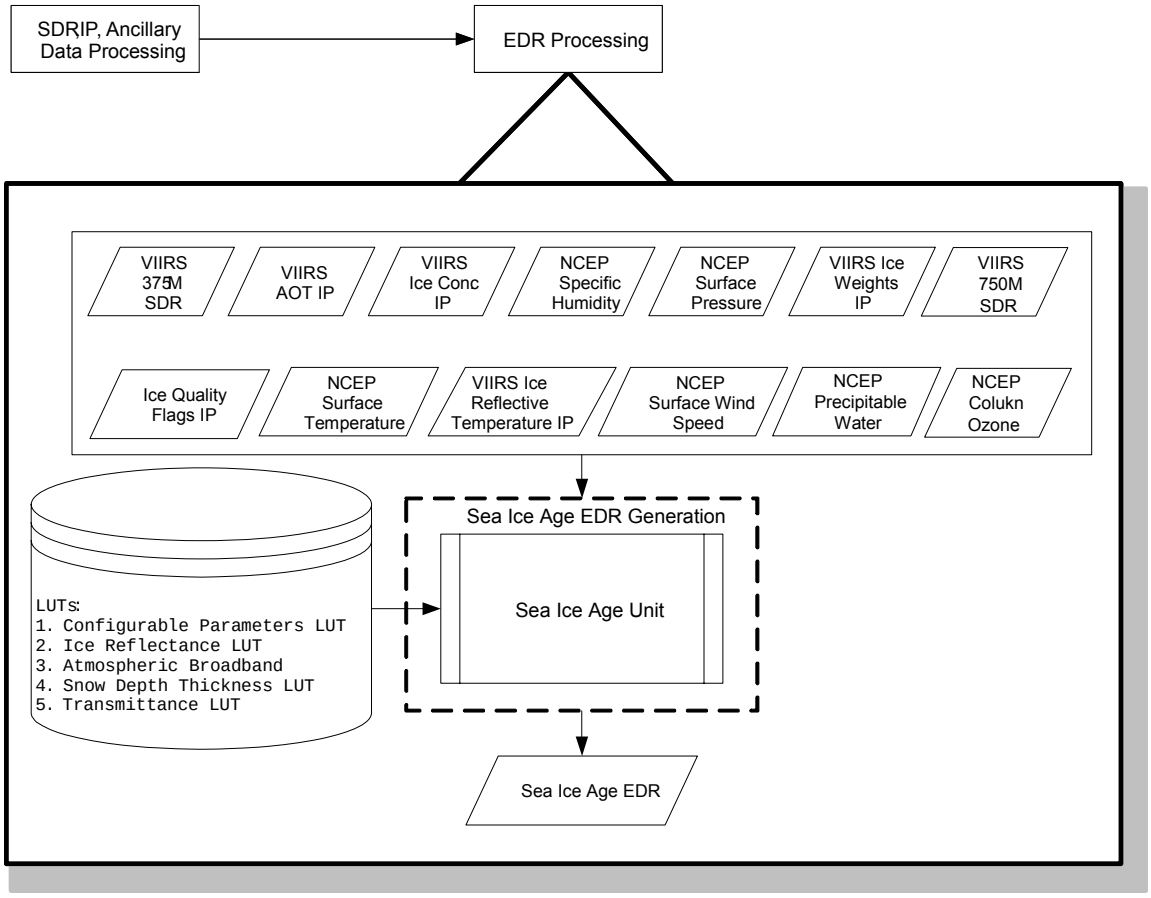

Figure 1. Sea Ice Age EDR Processing Chain

2.1 Sea Ice Characterization EDR Description

The Sea Ice Characterization EDR retrieval algorithm and the theoretical basis are described in detail in the VIIRS Sea Ice Characterization ATBD, D41063.

2.1.1 Interfaces

The Sea Ice Characterization algorithm, Ice Age, EDR output is not an input to other algorithms.

2.1.1.1 Inputs

Table 3 describes the Sea Ice Age global attributes. Table 4 describes the main inputs for Sea Ice Age.

Table 3. Global Attributes (Sea Ice Age)

Input	Type	Description/Source	Units/Valid Range
VIIRS_RDR_SCANS	Int32	Number of RDR scans	Unitless/ VIIRS_RDR_SCANS > 0 ***(Currently set to 48)***
M_DETECTORS	Int32	Number of Moderate detectors	Unitless/ M_DETECTORS > 0 ***(Currently set to 16)***
I_DETECTORS	Int32	Number of Image detectors	Unitless/ I_DETECTORS > 0 ***(Currently set to 32)***
M_VIIRS_SDR_ROWS	Int32	Number of moderate Viirs rows	Unitless/ VIIRS_RDR_SCANS * M_DETECTORS
M_VIIRS_SDR_COLS	Int32	Number of moderate Viirs columns	Unitless/ M_VIIRS_SDR_COLS > 0 ***(Currently set to 3200)***
I_VIIRS_SDR_ROWS	Int32	Number of image Viirs rows	Unitless/ VIIRS_RDR_SCANS * I_DETECTORS
I_VIIRS_SDR_COLS	Int32	Number of image Viirs columns	Unitless/ I_VIIRS_SDR_COLS > 0 ***(Currently set to 6400)***
IC_BANDS	Int32	Number of bands, extracted from the Ice Quality Flags IP, now represent band I1, I2, and surface temperature (not I5 brightness temperature values)	Unitless/ IC_BANDS > 0 ***(Currently set to 3 => I1,I2,STIP)***
VIIRS_MODERATE_PIXEL_COUNT	Int32	Number of moderate columns X rows	Unitless/ M_VIIRS_SDR_ROWS * M_VIIRS_SDR_COLS
sea_ice_out_of_range_granule	int*8	Flags whether the granule is entirely outside the sea ice range	Unitless/ 0 = No 1 = Yes
fw_ice_out_of_range_granule	int*8	Flags whether the granule is entirely outside the fresh water ice range	Unitless/ 0 = No 1 = Yes

Table 4. Main Inputs (Sea Ice Age)

Input	Data Type/Size	Description/Source	Units/Valid Range
scanStartTime	Int*64 x VIIRS_RDR_SCANS	Start Time of Scan in IET, from the IMG Geolocation SDR	Microseconds 0 to 1E+38
scanMidTime	Int*64 x VIIRS_RDR_SCANS	Mid Time of Scan in IET, from the IMG Geolocation SDR	Microseconds 0 to 1E+38
Latitude	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Latitude @ Imagery Resolution, from the IMG Geolocation SDR	-90 ≤ Latitude ≤ 90 *FILL_VALUE = -999.9*
Longitude	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Longitude @ Imagery Resolution, from the IMG Geolocation SDR	-180 ≤ Longitude ≤ 180 *FILL_VALUE = -999.9*
SolZenAng	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Solar Zenith Angle @ Imagery Resolution, from the IMG Geolocation SDR	-90 ≤ SolZenAng ≤ 90 *FILL_VALUE = 32767* (Integer Scaled)
SenZenAng	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Sensor Zenith Angle @ Imagery Resolution, from the IMG Geolocation SDR	-90 ≤ SenZenAng ≤ 90 *FILL_VALUE = 32767* (Integer Scaled)

Input	Data Type/Size	Description/Source	Units/Valid Range
SolAziAng	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Solar Azimuth Angle @ Imagery Resolution, from the IMG Geolocation SDR	-180 ≤ SolAziAng ≤ 180 *FILL_VALUE = 32767* (Integer Scaled)
SenAziAng	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Sensor Azimuth Angle @ Imagery Resolution, from the IMG Geolocation SDR	-180 ≤ SenAziAng ≤ 180 *FILL_VALUE = 32767* (Integer Scaled)
Height	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Terrain height of the VIIRS pixels @ Imagery Resolution, from the IMG Geolocation SDR	Meters -400 <= Height <= 10000
Range	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	The distance from the ground position represented by the pixel to the S/C @ Imagery Resolution, from the IMG Geolocation SDR	Meters 800000<=Range <=2000000
scPosition	float*32 x VIIRS_RDR_SCANS	Spacecraft position in orbit at mid-scan time	Meters -7.46E+06 <= Position <= 7.46E+06
scVelocity	float*32 x VIIRS_RDR_SCANS	Spacecraft velocity in orbit at mid-scan time	Meters/second -6600 <= Velocity <= 6600
scAttitude	float*32 x VIIRS_RDR_SCANS	Spacecraft attitude in orbit at mid-scan time	Arcseconds -648000 <= Attitude <= 648000
scanFlags	UInt8* x VIIRS_RDR_SCANS	Scan quality flags, from the IMG Geolocation SDR	Unitless/
PixelQuality	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Pixel quality flags from the IMG Geolocation SDR	Unitless/
Actual Scans	Int*32	Number of scans in the granule, from the IMG Geolocation SDR	Unitless/ Actual Scans > 0
Ice Quality Flags	int8* x IC_BANDS x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Ice Quality Flags **Error! Reference source not found.**from the ***Ice Quality Flags IP***	See Sea Ice Quality IP and STIP OAD **Error! Reference source not found.**
Ice Weights	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Output Ice Weights for each Imagery Band (I1, I2, I5- corresponds to Surface Temperature) from the ***Ice Weights IP***	Unitless/ 0.0 ≤ Ice Weights ≤ 1.0
IceTiePoints	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Ice Tie Points computed for the two reflectance bands and the STIP, from the ***Ice Reflectance and Ice Temperature IP***	Unitless/ IceTiePoints ≥ 0 *FILL_VALUE = -999.99*
IceFraction	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Ice Fraction, from the ***Ice Concentration IP***	Unitless/ 0.0 ≤ IceFraction ≤ 1.0 *FILL_VALUE = -999.00*
ConcWgt	float*32 x I_VIIRS_SDR_ROWS x I_VIIRS_SDR_COLS	Ice Concentration Weights, ***from the Ice Concentration IP***	Unitless/ 0.0 ≤ ConcWgt ≤ 1.0
AOT	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	Aerosol Optical Thickness (550 nm) @ 750m, from the ***AOT IP***	Unitless/ AOT ≤ 1.0 *FILL_VALUE = -999.9*
O3	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Column Ozone	Atm-cm / 0.5 ≤ O3 ≤ 6.5 *FILL_VALUE = -999.00*
PW	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Precipitable Water	cm/ 0.0 ≤ PW ≤ 10.0 *FILL_VALUES = -999.00*
Surf_Temp	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Surface Air Temperature/	Kelvin/ 213 ≤ Surf_Temp ≤ 343 *FILL_VALUES = -999.00*

Input	Data Type/Size	Description/Source	Units/Valid Range
SWS	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Surface Wind Speed	m/s / 0 ≤ SWS ≤ 25 *FILL_VALUES = -999.00*
Surf_Pres	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Surface Pressure	millibars (mb)/ 200 ≤ Surf_Pres ≤ 1200 *FILL_VALUES = -999.00*
Specific_hum	float*32 x M_VIIRS_SDR_ROWS x M_VIIRS_SDR_COLS	NCEP Surface Air Specific Humidity	Unitless/ 0.0 ≤ Surf_RH ≤ 1.0 *FILL_VALUES = -999.00*
Ice Age LUT	See Table 5	See Table 5	See Table 5
Ice Reflectance LUT	See Table 6	See Table 6	See Table 6
SnowDepth /Ice Thickness LUT	See Table 7	See Table 7	See Table 7
Broadband Transmittance LUT	See Table 8	See Table 8	See Table 8

The Sea Ice Age unit requires several input data files that are generated offline. LUTs are required for the modeled ice TOA reflectance, atmospheric transmittance, broad band spectral albedo, narrow band spectral albedo, and Climatology Snow Depth-Ice Thickness (data base). Contents of the modeled ice Top of Atmosphere (TOA) reflectance LUT are described in Table 6. The TOA reflectance LUT is required to be rerun only if errors are detected in the table values or to improve accuracy of the reflectances. The TOA reflectance LUT delivered has been generated using a LUT generation tool at NGST. Contents of the broadband albedo and spectral albedo LUTs are also defined in Table 6. Currently, the broadband albedo LUT is populated with values only for the VIIRS I1 band. A true broadband albedo and spectral albedo for I2 must be generated as an offline process using a radiative transfer model. The software to generate the broadband albedo and spectral albedo LUTs is to be developed as a post drop activity. (TBD01)

The atmospheric transmittance LUT and Climatology Snow Depth-Ice-Thickness LUTs have been generated by ITSS according to the description provided in the VIIRS Ice Age LUT Generation document, DAL No. D277c, ITSS Document number ME60822-VIR-022. Table 7 details the Snow Depth/Ice Thickness LUT information.

Table 5. Ice Age LUT

Input	Data Type/Size	Description/Source	Units/Valid Range
h00	float*32	Young/First Year ice thickness threshold (cm)	cm >0.0 **(Currently set to 30.0)**
min_conc	float*32	Minimum ice concentration for ice age processing	Unitless 0.0 ≤ min_conc ≤ 1.0 ***(Currently set to 0.10)***
min_twgt	float*32	Minimum temperature weight for processing	Unitless 0.0 ≤ min_twgt ≤ 1.0 ***(Currently set to 0.05)***
max_thick_dev	float*32	Maximum allowed difference between I1 and I2 thickness	cm > 0.0 ***(Currently set to 5.0)***
q0	float*32	Solar irradiance (W/m^2)	W/m^2 >0.0 **(Currently set to 1368)**
atmo_const	float*32 x (2 constants)	Atmospheric constants (empirical) used to compute long wave heat flux as a function of humidity and temperature	Unitless >0.0 ***(Currently set to 0.65; 0.055)***

Input	Data Type/Size	Description/Source	Units/Valid Range
ct	float*32	Coefficient of turbulent heat exchange (sensible heat)	Unitless >0.0 **(Currently set to 0.0017)**
ce	float*32	Coefficient of turbulent heat exchange (latent heat)	Unitless >0.0 **(Currently set to 0.0017**
specific_heat	float*32	Specific heat (J/kg/K)	J/kg/K >0.0 **(Currently set to 1005)**
latent_heat	float*32	Latent heat of evaporation (J/kg)	J/kg/K >0.0 **(Currently set to 2.456E6)**
latent_heat_fus	float*32	Latent heat of fusion (J/kg)	J/kg >0.0 **(Currently set to 3.E5)**
sb_const	float*32	Stephan-Boltzmann constant (W/m^2/K^4)	W/m^2/K^4 5.6704E-8
n_emiss	float*32	Number of emissivity bins	Unitless >0.0 **(Currently set to 1.0)**
emiss	float*32	Surface emissivity	Unitless 0 <= emiss <= 1.0 **(Currently set to 1.0)**
ice_conduct	float*32	Ice conductivity (W/m/K)	W/m/K >0.0 **(Currently set to 2.093)**
snow_conduct	float*32	Snow conductivity (W/m/K)	W/m/K >0.0 **(Currently set to 0.279)**
t_freeze	float*32	Freezing point of sea water (K)	deg. K 271.4
n_refl_bins	float*32	Number of reflectance bins for reflectance noise model	Unitless >=1 **(Currently set to 1.0)**
sza_thre_r	float*32	Red/Yellow SZA threshold for energy balance	degrees 0< sza_thre_r < 90 **(Currently set to 80.0)**
sza_thre_y	float*32	Yellow/Green SZA threshold (Degrees) for energy balance	degrees 0< sza_thre_r < 90 **(Currently set to 85.0)**
trans_thre_r	float*32	Red/Yellow SZA threshold (Degrees) for transmittance	degrees 0< sza_thre_r < 90 **(Currently set to 76.0)**
arctic_haze_aot_thresh	float*32	Arctic haze aerosol optical thickness threshold	Unitless (**Currently set to 0.1)**
iceAirDeltaT	float*32	Temperature difference threshold for Ice-Surface Air Temperature	Degrees C (**Currently set to -999.0**) Note: Setting the threshold to -999.0 effectively disables a branch to classify ice age First Year using a temperature difference threshold. This will allow the algorithm to fully utilize the energy balance equation.

Table 6. Sea Ice Reflectance LUT

Input	Data Type/Size	Description/Source	Units/Valid Range
n_am	float*32	Number of Aerosol Models	Unitless n_am = 2
n_bands	float*32	Number of Imagery Bands (I1, I2)	Unitless n_bands = 2
n_thick	float*32	Number Ice Thickness Bin Values	Unitless n_thick = 5
thick	float*32	Ice Thickness Bin Values	cm thick = [5,10,20,30,40]
n_depth	float*32	Number of Snow Depth Values	Unitless n_depth = 6
depth	float*32 x n_depth	Snow Depth Bin Values	cm depth = [0.0, 0.25, 0.5, 1.0, 2.0, 3.0]
n_aot	float*32	Number of AOT Bin Values	Unitless n_aot = 4
aot	float*32 x n_aot	AOT Bin Values	Unitless aot = [0.0, 0.2366, 0.5472,1.0]
n_wvot	float*32	Number of Precipitable Water Bin Values	Unitless n_wvot = 3
wvot	float*32 x n_wvot	Precipitable Water Bin Values	gm/cm^2 wvot = [0.0, 0.4323, 2.0]
n_oot	float*32	Number of Ozone Column Bin Values	Unitless n_oot = 3
oot	float*32 x n_oot	Ozone Column Bin Values	cm-atm oot = [0.0, 0.1967, 0.5]
n_sza	float*32	Number of Solar Zenith Angle Bin Values	Unitless n_sza = 11
sza_bins	float*32 x n_sza	Solar Zenith Angle Bin Values	Unitless (values are cosines) -1.0 <= sza_bins <= 1.0 sza_bins = Equally spaced in cos(sza) from 0:85 degrees
n_vza	float*32	Number of View Zenith Bin Values	Unitless n_vza = 7
vza_bins	float*32 x n_vza	View Zenith Angle Bin Values	Unitless (values are cosines) -1.0 <= vza_bins <= 1.0 vza_bins = Equally spaced in cos(vza) from 0:70 degrees
n_relaz	float*32	Number of Relative Azimuth Angle Bin Values	Unitless n_relaz = 7
relaz_bins	float*32 x n_relaz	Relative Azimuth Angle Bin Values	Degrees 0 <= relaz_bins <= 180. relaz_bins = [0, 30, 60, 90,120,150,180]
ice_albedo	float*32 x n_thick x n_depth	Broadband From 6s radiative transfer model (RTM)	Unitless 0.0 <= ice_albedo <= 1.0
albedo_spectral	float*32 x n_nthick x ndepth x n_bands	Spectral Albedo from 6s RTM	Unitless 0.0 <= spectral_albedo <= 1.0

Input	Data Type/Size	Description/Source	Units/Valid Range
toa_reflectance	float*32 x n_am x n_bands x n_thick x n_depth x n_aot x n_wvot x n_oot x n_sza x n_vza x n_relaz	TOA Reflectances From 6s RTM	Unitless >0.0

Table 7. Snow Depth/Ice Thickness LUT

Input	Data Type/Size	Description/Source	Units/Valid Range
n_nlat	float*32	Number of northern hemisphere latitudes	Unitless/ n_nlat > 0 n_nlat = 23
n_slat	float*32	Number of southern hemisphere latitudes	Unitless n_slat > 0 n_slat = 17
n_lon	float*32	Number of longitudes	Unitless n_lon > 0 n_lon = 145
n_date	float*32	Number of date bins (months)	Unitless n_date > 0 n_date = 13
n_ice	float*32	Number of ice thickness bins	Unitless n_ice > 0 n_ice = 5
nlat_bins	float*32 x n_nlat	Northern Hemisphere latitudes at 2.5 deg increments	Degrees -90 ≤ nlat_bins ≤ 90 nlat_bins = [35., 37.5, 40…85., 87.5, 90.]
slat_bins	float*32 x n_slat	Southern Hemisphere latitudes at 2.5 deg increments	Degrees -90 ≤ slat_bins ≤ 90 slat_bins = [-90., -87.5, -85…-55., -52.5, -50.]
lon_bins	float*32 x n_lon	Longitudes at 2.5 deg increments	Degrees -180 ≤ lon_bins ≤ 180 lon_bins = [0, 2.5, 5.0…355, 357.5, 360.]
date_bins	float*32 x n_date	Day of year for the middle of each month	Day number >0.0 date_bins = [15.5, 46., 76.5…320.5, 351., 381.5]
ice_bins	float*32 x n_ice	Ice thickness	cm >0.0 ice_bins = [5.0,10.0,20.0,30.0,40.0]
sdc_n	float*32 x n_ice x n_nlat x n_lon x n_date	Snow depth from climatology model for Northern Hemisphere	cm >0.0
sdc_s	float*32 x n_ice x n_slat x n_lon x n_date	Snow depth from climatology model for Northern Hemisphere	cm > 0.0

Table 8. Atmospheric Broadband Transmittance LUT

Input	Data Type/Size	Description/Source	Units/Valid Range
naot	int*8	Number of AOT Bins	Unitless naot > 0 ***(Currently set to 6)***
nsza	int*8	Number of Solar Zenith Angle Bins	Unitless nsza > 0 ***(Currently set to 11)***
aotbin	float*32 x naot	AOT Boundary Values	Unitless aotbin = [0.0,0.01,0.1,0.2,0.6,1.0]
szabin	float*32 x nsza	Solar Zenith Angle Boundary Values	Degrees/ -90 ≤ szabin ≤ 90, szabin = [48.0,52.0,56.0,60.0,64.0, 68.0,72.0,76.0,80.0,84.0, 88.0]
bbtranslut	float*32 x naot x nsza	Atmospheric Broadband Transmittance values, extracted from 6s RTM. In the "Units/Range" column, each set of "naot" values are represented by each pair of lines of data (three numbers in each line). The 11 pairs of lines represent "nsza".	Unitless/ bbtranslut = [0.913416,0.913416,0.883998, 0.852080,0.734581,0.634458;**(1)** 0.906948,0.906948,0.874509, 0.839625,0.714074,0.610474;**(2)** 0.898996,0.898996,0.862829, 0.824371,0.689830,0.583017;**(3)** 0.889093,0.889093,0.848281, 0.805525,0.661177,0.551780;**(4)** 0.876536,0.876536,0.829884, 0.781987,0.627344,0.516514;**(5)** 0.860251,0.860251,0.806199, 0.752198,0.587501,0.477124;**(6)** 0.838493,0.838493,0.774994, 0.713922,0.540873,0.433793;**(7)** 0.808251,0.808251,0.732683, 0.663920,0.487026,0.387159;**(8)** 0.763895,0.763895,0.673236, 0.597567,0.426465,0.338517;**(9)** 0.705639,0.705639,0.596868, 0.514757,0.359083,0.287918;**(10)** 0.633377,0.633377,0.503474, 0.415542,0.284933,0.235338]**(11)**

The Sea Ice Age EDR input file specifications are shown in Table 9.

Table 9. Sea Ice Age EDR Input File Specifications

Input	Object/Format	Source
VIIRS Ice Quality Flags IP	Binary	VIIRS Ice Quality IP Module
VIIRS Earth View 375-meter SDR	Binary	VIIRS SDR Module
VIIRS Earth View 750-meter SDR	Binary	VIIRS SDR Module
VIIRS Ice Location IP	Binary	VIIRS SDR Module

Input	Object/Format	Source
VIIRS Ice Reflectance and Temperature IPs	Binary	VIIRS Ice Concentration IP Module
VIIRS Ice Concentration IP	Binary	VIIRS Ice Concentration IP Module
VIIRS Cloud Optical Thickness (COT) IP	Binary	VIIRS COT IP Module
VIIRS AOT IP (550 nm AOT)	Binary	VIIRS AOT IP Module
NCEP Ozone Total Column	Binary	Ancillary Data Processing
NCEP Precipitable Water	Binary	Ancillary Data Processing
NCEP Surface Specific Humidity	Binary	Ancillary Data Processing
NCEP Surface Air Temperature	Binary	Ancillary Data Processing
NCEP Surface Pressure	Binary	Ancillary Data Processing
NCEP Surface Wind Speed	Binary	Ancillary Data Processing
Ice Age LUT	ASCII	Lookup Table Generation
Sea Ice Reflectance LUT	Binary	Lookup Table Generation
Snow Depth/Ice Thickness LUT	ASCII	Lookup Table Generation
Broadband Transmittance LUT	ASCII	Lookup Table Generation

It should be noted in Table 5 (Ice Age LUT) that the minimum temperature band weight tunable parameter “min_twgt” has been changed to 0.05, from that of 0.25 as originally defined in the detailed design document. During unit testing it was determined that the value of min_twgt must be less than that of the “band_wgts” of 0.1. If min_twgt is greater than band_wgts, all pixels based on temperature are filtered and thus all night pixel retrievals for ice age fail.

2.1.1.2 Outputs

The Sea Ice Age Unit outputs the Sea Ice Age Characterization EDR. Table 10 shows the Sea Ice Age EDR output with horizontal cell resolution. The EDR is reported at aggregated resolution based on the value of the constant “hcsize”.

The CELL_SIZE parameter is the aggregated pixel resolution. The aggregated cell size is defined as:

$$CELL\_SIZE = hcsize.$$

The setting for hcsize for 2x2 aggregation to be performed is hcsize=2.

Table 10. Sea Ice Age EDR Output Description

Output	Data Type/Size	Description	Units/Valid Range
IceAgeWeight	float*32 x HCROWS x HCCOLS	Ice Age Weighting Factors for I1, I2, STIP and weighted cell total	Unitless 0.0 ≤ IceAgeWeight ≤1.0
IceAgeQuality	uint*8 x 3 x HCROWS x HCCOLS	See Table 11, Sea Ice Age Pixel-Level Quality Flags	See Table 11, Sea Ice Age Pixel-Level Quality Flags
IceAge	int*8 x HCROWS x HCCOLS	Various classifications of ice for I1, I2, STIP, and weighted cell total	Unitless/ 0 = Unclassified Fill 1 = Water 2 = New or Young Ice 3 = spare 4 = All other Ices 5-9 = spare 10 = Land Fill 11 = spare 12 = Cloud Fill

Table 11. Sea Ice Age Pixel-Level Quality Flags

BYTE	Bit	Flag Description Key	Result
0	0-1	Ice Age Overall Quality	00 = GREEN (good) 01 = YELLOW (degraded) 10 = RED (bad) 11 = No Retrieval (Fill)
	2	Input SDR & STIP quality (bands I1, I2, STIP)	0 = Good 1 = Bad
	3-4	Cloud Confidence	00 = confidently clear 01 = probably clear 10 = probably cloudy 11 = confidently cloudy
	5	Thermal Contrast Degradation	0 = No, 1 = Yes (1.5K<Thermal Contrast<2.2K) Open Water Temp– Ice Temp
	6	Sea ice valid region Exclusion	0 = Good (pixel within valid processing region) 1 = Excluded (pixel is not within a valid processing region) Valid latitude ranges are lat > 36deg N. or lat > 50deg S. Valid regions are also only over oceans
	7	Aerosol Optical Thickness Exclusion	0 = No 1 = Yes (550nm AOT exclusion condition slant path aot > 1.0)
1	0	Thermal Contrast Exclusion	0 = No 1 = Yes (Thermal Contrast <1.5K)
	1	No Ice in Cell	0 = Ice in cell (ice present if conc > min_conc) 1 = No Ice in cell detected (exclusion set for no ice)
	2	Ocean/No ocean exclusion	0 = Ocean 1 = No Ocean
	3-4	Algorithm Branching	Unclassed 00 RT : Reflectance Threshold Method 01 THB : Thermal Heat Balance Method 10
	5	Heavy Aerosol	0 = No heavy aerosol 1 = Heavy aerosol
	6	Spare	Spare
	7	Thin Cirrus (based on VCM thin cirrus flag)	0 = No 1 = Yes (thin cirrus detected)
2	0	Shadow Detected	0 = No cloud shadow 1 = Cloud shadow detected
	1-2	Cloud Phase	clear; (00) water; (01) ice; (10) mixed (11)
	3	Fire Detected	0 =No 1 = Yes
	4	Sun Glint	0 =No 1 = Yes
	5	Coast Line	0 =No 1 = Yes (coast line within cell)
	6	Spare	Spare
	7	Spare	Spare

The Sea Ice Age EDR attributes are shown in Table 12.

Table 12. Sea Ice Age EDR Attributes/Metadata

Attribute	Data Type/Size	Description
sea_ice_out_of_range_granule	int*8	Flags whether the granule is entirely outside the sea ice range (1=YES, 0 = NO)

2.1.2 Algorithm Processing

2.1.2.1 Main Module – IA_main:

IA_main is the main driver for Sea Ice Age Unit. The processing approach developed for the Sea Ice Characterization algorithm, Ice Age, is based on per pixel processing of imagery resolution pixels in a granule. The output Sea Ice Age EDR is reported at an aggregated (2x2) horizontal cell resolution.

2.1.2.2 IA_snow_depth_ice_thickness:

IA_snow_depth_ice_thickness extracts the snow-depth-to-ice-thickness ratios from Snow Depth / Ice Thickness LUT.

2.1.2.3 IA_extract_ice_reflectance_lut:

IA_extract_ice_reflectance_lut extracts and interpolates the ice reflectance LUT.

2.1.2.4 IA_reflect_threshold:

IA_reflect_threshold computes the reflectance threshold model.

2.1.2.5 IA_energy_balance:

IA_energy_balance computes the energy balance model using ice temperature data.

2.1.2.6 IA_ice_age:

IA_ice_age determines ice age.

2.1.2.7 IA_set_qflags:

IA_set_qflags sets the pixel level quality flags.

2.1.3 Graceful Degradation

2.1.3.1 Graceful Degradation Inputs

There are two cases where input graceful degradation is indicated in the Ice Age:

1. A primary input denoted in the algorithm configuration guide cannot be successfully retrieved but an alternate input can be retrieved

2. An input that is retrieved for an algorithm has the N_Graceful_Degradation metadata field set (propagation)

Table 13 details the instances of these cases. Note that the shaded cells indicate that the graceful degradation was done upstream at product production.

Table 13. Graceful Degradation

Input Data Description	Baseline Data Source	Primary Backup Data Source	Secondary Backup Data Source	Tertiary Backup Data Source	Graceful Degradation Done Upstream
Sea Surface Wind	VIIRS_GD_09.4.2 NCEP	VIIRS_GD_09.4.2 NCEP	N/A	N/A	Yes

Input Data Description	Baseline Data Source	Primary Backup Data Source	Secondary Backup Data Source	Tertiary Backup Data Source	Graceful Degradation Done Upstream
Speed and Direction		(Extended Forecast)			
Adjusted Surface Pressure	VIIRS_GD_28.4.1 NCEP	VIIRS_GD_28.4.1 NCEP (Extended Forecast)	N/A	N/A	Yes
Surface Air Temperature	VIIRS_GD_09.4.10 NCEP	VIIRS_GD_09.4.10 NCEP (Extended Forecast)	N/A	N/A	Yes
Specific Humidity at Surface	VIIRS_GD_09.4.12 NCEP	VIIRS_GD_09.4.12 NCEP (Extended Forecast)	N/A	N/A	Yes
Aerosol Optical Thickness	VIIRS_GD_15.4.1 VIIRS AOT IP	VIIRS_GD_25.4.1 NAAPS	VIIRS_GD_15.4.1 Climatology	N/A	Yes, backup only
Total Column Precipitable Water	VIIRS_GD_09.4.11 NCEP	VIIRS_GD_09.4.11 NCEP (Extended Forecast)	N/A	N/A	Yes
Total Column Ozone	VIIRS_GD_09.4.1 NCEP	VIIRS_GD_09.4.1 NCEP (Extended Forecast)	N/A	N/A	Yes

2.1.3.2 Graceful Degradation Processing

None.

2.1.3.3 Graceful Degradation Outputs

None.

2.1.4 Exception Handling

The current implementation of the software does not allow the program to continue execution if an invalid value of surface pressure or other input IP value is encountered.

2.1.5 Data Quality Monitoring

It was determined that a Data Quality Notification (DQN) was needed for the Ice Age output latitude, longitude, weight, and age. The DQN test looks for any output pixel which is set to NA, MISS, or ERR. If the test is true, a product is populated into DMS that contains what check was done and how many pixels were within this range. For a detailed description of DQN, please refer to the Processing SI Common IO Design, DD60822-IDP-011, Section 6.3.

2.1.6 Computational Precision Requirements

Single precision 32-bit floating point computations are required.

2.1.7 Algorithm Support Considerations

Tunable parameters (in a LUT or processing coefficient file) are updated and provided to IDPS by DQM…in an operational system. Table 14 contains tunable algorithm parameters. Note: The “hcsize” constant controls the aggregation cell size that is used for the Ice Age EDR. The setting of hcsize is hcsize =2 and results in 2x2 aggregation.

Note: In the current version of the Ice Age Algorithm source code, several temperature threshold values remain defined as hard coded numeric values in subroutine IA_energy_balance. IDPS should implement these thresholds as tunable parameters. (TBD02) The value 200.0 degrees Kelvin should be defined as a tunable parameter named “min_ice_temp”. The value 200 degrees Kelvin should be defined as a tunable parameter named “min_surf_air_temp”. The value 269 degrees Kelvin should be defined as a tunable

parameter named “max_surf_air_temp”. The value 2 Kelvin degrees should be defined as a tunable parameter named “max_iceair_deltaT”.

Table 14. List of Tunable Algorithm Parameters

Input	Data Type/Size	Description	Units/Valid Range
h00	float*32	Young/First Year ice thickness threshold (cm)	Cm > 0.0 (Currently set to 30.0)
min_conc	float*32	Minimum ice concentration for ice age processing	0.1
min_twgt	float*32	Minimum temperature weight for processing	Unitless 0.0 ≤ min_twgt ≤ 1.0 ***(Currently set to 0.05)***
max_thick_dev	float*32	Maximum allowed difference between I1 and I2 thickness	cm > 0.0 ***(Currently set to 5.0)***
q0	float*32	Solar irradiance (W/m^2)	W/m^2 >0.0 **(Currently set to 1368)**
atmo_const	float*32 x (2 constants)	Atmospheric constants	Unitless >0.0 ***(Currently set to 0.65; 0.055)***
ct	float*32	Coefficient of turbulent heat exchange (sensible heat)	Unitless >0.0 **(Currently set to 0.0017)**
ce	float*32	Coefficient of turbulent heat exchange (latent heat)	Unitless >0.0 **(Currently set to 0.0017**
specific_heat	float*32	Specific heat (J/kg/K)	J/kg/K >0.0 **(Currently set to 1005)**
latent_heat	float*32	Latent heat of evaporation (J/kg)	J/kg/K >0.0 **(Currently set to 2.456E6)**
latent_heat_fus	float*32	Latent heat of fusion (J/kg)	J/kg >0.0 **(Currently set to 3.E5)**
sb_const	float*32	Stephan-Boltzmann constant (W/m^2/K^4)	W/m^2/K^4 5.6704E-8
n_emiss	float*32	Number of emissivity bins	Unitless >0.0 **(Currently set to 1.0)**
emiss	float*32	Surface emissivity	Unitless 0 <= emiss <= 1.0 **(Currently set to 1.0)**
ice_conduct	float*32	Ice conductivity (W/m/K)	W/m/K >0.0 **(Currently set to 2.093)**
snow_conduct	float*32	Snow conductivity (W/m/K)	W/m/K >0.0 **(Currently set to 0.279)**
t_freeze	float*32	Freezing point of sea water (K)	deg. K 271.4
sza_thre_r	float*32	Red/Yellow SZA threshold for energy balance	degrees 0< sza_thre_r < 90 **(Currently set to 80.0)**
sza_thre_y	float*32	Yellow/Green SZA threshold (Degrees) for energy balance	degrees 0< sza_thre_r < 90 **(Currently set to 85.0)**
trans_thre_r	float*32	Red/Yellow SZA threshold (Degrees) for transmittance	degrees 0< sza_thre_r < 90 **(Currently set to 76.0)**
arctic_haze_aot	float*32	Arctic haze aerosol optical thickness threshold	Unitless

Input	Data Type/Size	Description	Units/Valid Range
_thresh			(**Currently set to 0.1)**
IceAirDeltaT	float*32	Temperature difference threshold for Ice-Surface Air Temperature	Degrees C (**Currently set to -999.0**) Note: Setting the threshold to -999.0 effectively disables a branch to classify ice age First Year using a temperature difference threshold. This will allow the algorithm to fully utilize the energy balance equation.

2.1.8 Assumptions and Limitations

None.

3.0 GLOSSARY/ACRONYM LIST

3.1 Glossary

The current glossary for the NPOESS program, D35836_G_NPOESS_Glossary, can be found on eRooms. Table 15 contains those terms most applicable for this OAD.

Table 15. Glossary

TERM	DESCRIPTION
Algorithm	A formula or set of steps for solving a particular problem. Algorithms can be expressed in any language, from natural languages like English to mathematical expressions to programming languages like FORTRAN. On NPOESS, an algorithm consists of: 1. A theoretical description (i.e., science/mathematical basis) 2. A computer implementation description (i.e., method of solution) 3. A computer implementation (i.e., code)
Algorithm Configuration Control Board (ACCB)	Interdisciplinary team of scientific and engineering personnel responsible for the approval and disposition of algorithm acceptance, verification, development and testing transitions. Chaired by the Algorithm Implementation Process Lead, members include representatives from IWPTB, Systems Engineering & Integration IPT, System Test IPT, and IDPS IPT.
Algorithm Verification	Science-grade software delivered by an algorithm provider is verified for compliance with data quality and timeliness requirements by Algorithm Team science personnel. This activity is nominally performed at the IWPTB facility. Delivered code is executed on compatible IWPTB computing platforms. Minor hosting modifications may be made to allow code execution. Optionally, verification may be performed at the Algorithm Provider's facility if warranted due to technical, schedule or cost considerations.
Ancillary Data	Any data which is not produced by the NPOESS System, but which is acquired from external providers and used by the NPOESS system in the production of NPOESS data products.
Auxiliary Data	Auxiliary Data is defined as data, other than data included in the sensor application packets, which is produced internally by the NPOESS system, and used to produce the NPOESS deliverable data products.
EDR Algorithm	Scientific description and corresponding software and test data necessary to produce one or more environmental data records. The scientific computational basis for the production of each data record is described in an ATBD. At a minimum, implemented software is science-grade and includes test data demonstrating data quality compliance.
Environmental Data Record (EDR)	*[IORD Definition]* Data record produced when an algorithm is used to convert Raw Data Records (RDRs) to geophysical parameters (including ancillary parameters, e.g., cloud clear radiation, etc.). *[Supplementary Definition]* An Environmental Data Record (EDR) represents the state of the environment, and the related information needed to access and understand the record. Specifically, it is a set of related data items that describe one or more related estimated environmental parameters over a limited time-space range. The parameters are located by time and Earth coordinates. EDRs may have been resampled if they are created from multiple data sources with different sampling patterns. An EDR is created from one or more NPOESS SDRs or EDRs, plus ancillary environmental data provided by others. EDR metadata contains references to its processing history, spatial and temporal coverage, and quality.
Model Validation	The process of determining the degree to which a model is an accurate representation of the real-world from the perspective of the intended uses of the model. [Ref.: DoDD 5000.59-DoD Modeling and Simulation Management]
Model Verification	The process of determining that a model implementation accurately represents the developer's conceptual description and specifications. [Ref.: DoDD 5000.59-DoD Modeling and Simulation Management]
Operational Code	Verified science-grade software, delivered by an algorithm provider and verified by IWPTB, is developed into operational-grade code by the IDPS IPT.

TERM	DESCRIPTION
Operational-Grade Software	Code that produces data records compliant with the System Specification requirements for data quality and IDPS timeliness and operational infrastructure. The software is modular relative to the IDPS infrastructure and compliant with IDPS application programming interfaces (APIs) as specified for TDR/SDR or EDR code.
Raw Data Record (RDR)	*[IORD Definition]* Full resolution digital sensor data, time referenced and earth located, with absolute radiometric and geometric calibration coefficients appended, but not applied, to the data. Aggregates (sums or weighted averages) of detector samples are considered to be full resolution data if the aggregation is normally performed to meet resolution and other requirements. Sensor data shall be unprocessed with the following exceptions: time delay and integration (TDI), detector array non-uniformity correction (i.e., offset and responsivity equalization), and data compression are allowed. Lossy data compression is allowed only if the total measurement error is dominated by error sources other than the data compression algorithm. All calibration data will be retained and communicated to the ground without lossy compression. *[Supplementary Definition]* A Raw Data Record (RDR) is a logical grouping of raw data output by a sensor, and related information needed to process the record into an SDR or TDR. Specifically, it is a set of unmodified raw data (mission and housekeeping) produced by a sensor suite, one sensor, or a reasonable subset of a sensor (e.g., channel or channel group), over a specified, limited time range. Along with the sensor data, the RDR includes auxiliary data from other portions of NPOESS (space or ground) needed to recreate the sensor measurement, to correct the measurement for known distortions, and to locate the measurement in time and space, through subsequent processing. Metadata is associated with the sensor and auxiliary data to permit its effective use.
Retrieval Algorithm	A science-based algorithm used to 'retrieve' a set of environmental/geophysical parameters (EDR) from calibrated and geolocated sensor data (SDR). Synonym for EDR processing.
Science Algorithm	The theoretical description and a corresponding software implementation needed to produce an NPP/NPOESS data product (TDR, SDR or EDR). The former is described in an ATBD. The latter is typically developed for a research setting and characterized as "science-grade".
Science Algorithm Provider	Organization responsible for development and/or delivery of TDR/SDR or EDR algorithms associated with a given sensor.
Science-Grade Software	Code that produces data records in accordance with the science algorithm data quality requirements. This code, typically, has no software requirements for implementation language, targeted operating system, modularity, input and output data format or any other design discipline or assumed infrastructure.
SDR/TDR Algorithm	Scientific description and corresponding software and test data necessary to produce a Temperature Data Record and/or Sensor Data Record given a sensor's Raw Data Record. The scientific computational basis for the production of each data record is described in an Algorithm Theoretical Basis Document (ATBD). At a minimum, implemented software is science-grade and includes test data demonstrating data quality compliance.
Sensor Data Record (SDR)	*[IORD Definition]* Data record produced when an algorithm is used to convert Raw Data Records (RDRs) to calibrated brightness temperatures with associated ephemeris data. The existence of the SDRs provides reversible data tracking back from the EDRs to the Raw data. *[Supplementary Definition]* A Sensor Data Record (SDR) is the recreated input to a sensor, and the related information needed to access and understand the record. Specifically, it is a set of incident flux estimates made by a sensor, over a limited time interval, with annotations that permit its effective use. The environmental flux estimates at the sensor aperture are corrected for sensor effects. The estimates are reported in physically meaningful units, usually in terms of an angular or spatial and temporal distribution at the sensor location, as a function of spectrum, polarization, or delay, and always at full resolution. When meaningful, the flux is also associated with the point on the Earth geoid from which it apparently originated. Also, when meaningful, the sensor flux is converted to an equivalent top-of-atmosphere (TOA) brightness. The associated metadata includes a record of the processing and sources from which the SDR was created, and other information needed to understand the data.

TERM	DESCRIPTION
Temperature Data Record (TDR)	*[IORD Definition]* Temperature Data Records (TDRs) are geolocated, antenna temperatures with all relevant calibration data counts and ephemeris data to revert from T-sub-a into counts. *[Supplementary Definition]* A Temperature Data Record (TDR) is the brightness temperature value measured by a microwave sensor, and the related information needed to access and understand the record. Specifically, it is a set of the corrected radiometric measurements made by an imaging microwave sensor, over a limited time range, with annotation that permits its effective use. A TDR is a partially-processed variant of an SDR. Instead of reporting the estimated microwave flux from a specified direction, it reports the observed antenna brightness temperature in that direction.

3.2 Acronyms

The current acronym list for the NPOESS program, D35838_G_NPOESS_Acronyms, can be found on eRooms. Table 16 contains those terms most applicable for this OAD.

Table 16. Acronyms

ACRONYM	DESCRIPTION
AM&S	Algorithms, Models & Simulations
API	Application Programming Interfaces
ARP	Application Related Product
CDFCB-X	Common Data Format Control Book - External
COT	Cloud Optical Thickness
DMS	Data Management Subsystem
DPIS ICD	Data Processor Inter-subsystem Interface Control Document
IET	IDPS Epoch Time
IIS	Intelligence and Information Systems
INF	Infrastructure
ING	Ingest
IP	Intermediate Product
LUT	Look-Up Table
MDFCB	Mission Data Format Control Book
PRO	Processing
PW	Precipitable Water
QF	Quality Flag
RTM	Radiative Transfer Model
SDR	Sensor Data Records
SI	Software Item or International System of Units
SWS	Surface Wind Speed
TBD	To Be Determined
TBR	To Be Resolved
TOA	Top of the Atmosphere
VCM	VIIRS Cloud Mask

4.0 OPEN ISSUES

Table 17. TBXs

TBX ID	Title/Description	Resolution Date
TBD01	Software development generating broadband albedo and spectral albedo LUTs	BX.X
TBD02	Guidance to implement hard coded thresholds as tunable parameters	BX.X